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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

SUPERVISION AND SAFETY OF THE BROOKLYN BRIDGE.

There are some engineering and architectural works which, if correctly designed and properly constructed, are safe for all time; there are others whose safety is directly proportional to the intelligence and care of the men (engineers or mechanics) appointed to supervise and keep them in repair. Prominent among the latter class of structures is the modern steel bridge, and particularly that type of it known as the stiffened suspension bridge, to which type the Brooklyn Bridge belongs. In the case of the great East River crossing, there are peculiarities in certain parts of the design and construction which demand a thorough knowledge of the theory of bridge construction on the part of its caretakers; for it is only a qualified engineer who would perceive just which are the points most liable to failure, and therefore calling for particularly close inspection. Such critical parts existed in the bridge from the very first, being inherent, as we have said, in the design; and their liability to overstrain has been greatly aggravated by the fact that, from the time construction was begun, various increments in the live loads have been allowed, until now much of the structural material of the bridge is being strained beyond the unit recognized as good practice by modern engineers, and some of it—as recent events have shown—beyond the breaking strength.

That actual breakage should have occurred, is to be attributed to lack of knowledge, or lack of care, or both. We are free to confess that recent utterances of the engineers in charge seem to indicate that they are not as familiar with the theoretical and practical aspects of the problem which is presented by the care and upkeep of this costly and overworked bridge, as the importance of the structure demands. For proof of this it is not necessary to go beyond the Chief Engineer's own report, in which he makes the astounding admission that the break in the suspender rods could not be detected until the broken ends were pulled up to view by the rising of the cable; while his assistant has asserted that the broken rods were sheared off by coming in contact with the upper edges of the floorbeam chords. What makes the Chief Engineer's statement the more disquieting is his admission that there had been previous breakages at this point of the bridge; for it is evident that even with practical evidence to back up theoretical indications of weakness, the bridge authorities either did not know how, or did not care, to use that simple method of inspection by a tap of the hammer, which is practised to-day on the tie-rods of every Howe truss on our Western railroads.

As a matter of fact, the whole atmosphere in and around the Engineer's office of the Brooklyn Bridge is particularly disquieting in view of the recent critical condition of the structure. There seems to have been too much of the "happy-go-lucky" about the management. Plans of parts seem to be difficult to find, and in some instances do not appear to exist. Is there on file in the Engineer's office a complete strain-sheet of the bridge under its present loading, showing the maximum stresses upon every member under the most unfavorable conditions of temperature and loading? Does this sheet show the actual tension in the outermost, diagonal over-floor stays, at maximum temperature and under maximum local concentration of load? When the trolleys were admitted upon the roadways, was any calculation made of the *dynamical* effect of the motor axles as they pound across the gap at the center of the main span? What is the tensional strain, under this hammering, at the center of the pair of channels which form the bottom chord of the floorbeams at this point? When the incident of the nine broken suspenders occurred, what was the increase of load thrown upon the suspenders, adjacent to the gap, which did not break? And what was the margin of resistance in these suspenders by which the process of snapping was prevented from running the full length of the truss and dropping the northern roadway into the river?

The Roeblings built a bridge which embodied the best engineering knowledge of twenty years ago, at a period when the theory and practice of bridge building, as we now know it, was not far removed from its infancy. In spite of its added loads the bridge is not an unsafe structure to-day—always provided (again we emphasize this point) that it is supervised by professional men who see to it that a most thorough system of inspection is unceasingly maintained.

THE NEW YORK CENTRAL RAILROAD TUNNEL NUISANCE.

On another page will be found the report of the grand jury's investigation of the two-mile tunnel, by which the New York Central Railroad reaches its terminal at Forty-second Street. We most heartily concur in the three recommendations of the grand jury, namely, that the wall dividing the two outer tunnels from the center tunnel be removed; that passenger coaches be protected from the sun when not in use; and that some other motive power than steam locomotives be used through the tunnel. The management of the New York Central road have only themselves to thank that this great public nuisance should have become the subject of action by the grand jury. Had the company shown the slightest indication of that anxiety to consider the comfort of their traveling patrons which, in recent press interviews, the leading officials of the road have claimed to experience, the present action of the grand jury, which is certainly not very creditable to this great and wealthy corporation, would never have been taken.

The discomfort due to heat and noxious gases is greatest in the side-tunnels, and the remedy suggested of cutting away the dividing walls and substituting for them steel columns and girders, would afford a very marked relief, by permitting the heat and gases to escape through the open wells which exist above the inside express tracks. If the company has a fraction of that solicitude for the public comfort of which they recently have made such loud protestations, the recommendation that during the hot weather passenger trains, when not in use, should be stored in sheds, to prevent their being heated by the rays of the sun, will meet with an instant response. As to the change of motive power, that also has to come; and it will be as well for the New York Central Company to realize at once that the public is determined that it shall come, and with as little delay as possible. The officials of the road have recently stated that they have been expending unlimited time and thought upon this problem, and regret to find that all of the alternative plans present insuperable difficulties, etc., etc. As a matter of fact, the public is beginning to realize that the most insuperable obstacle is the very large expense to which the company will be put by this alteration of its tunnels and this change of motive power. For the officials of the road to say that a change of motive power is mechanically impossible, is to trifle both with the subject and with the hundreds of thousands of passengers who are put to unnecessary discomfort and suffering by the present conditions. If the railroad company had the disposition to make the change, we venture to say that the electrical companies who are now equipping the Manhattan Elevated Railways would be perfectly willing to draw up a feasible scheme and put in bids for equipping the line from Mott Haven with the third-rail system, and providing the thirty or forty electrical locomotives necessary to bring the trains through the tunnel and handle them in the terminal yard. It is true, a third rail would involve some very complicated work at the numerous crossings and switches in the yard; but there is no reason to believe that these difficulties are beyond the ability of a good electrical engineer. The only objection to such an installation would be the three or four minutes delay in changing from steam to electric locomotive at Mott Haven. But this would be offset, as far as the operation of the road is concerned, by the convenience of having the steam locomotives disengaged at the round house, and saved from the round trip into and out of the terminal yard at Forty-second Street.

There can be no mistaking the genuineness of this last outburst of indignation against a railroad company of which the public has been such a liberal patron, and to which the city of New York has extended in the past such liberal concessions. We should have thought that with the construction of the Hudson River Bridge and the entrance of competing roads into Manhattan Island a probability, the New York Central would have been prompted by mere instincts of self-protection to remove a nuisance which is a standing disgrace to an otherwise admirable system.

DIVERGENT OPINIONS ON BATTLESHIP DESIGN.

Broadly speaking, and without the least disparagement of the ability and good judgment of the gentlemen composing the minority in the Naval Board on Construction, it must be admitted that there is what we might call an *a priori* presumption in favor of the superior excellence of the new type of battleship recommended to the Department, based on the significant fact that the three technical members of the Board are united in favor of the majority design. Rear Admiral Bowles is expertly qualified on the question of the structural arrangement of the hull and disposition of the armor; Rear Admiral Melville is similarly qualified to determine questions of motive power, coal supply, etc., while Rear Admiral O'Neil, by virtue of his office, is entitled to be called the most qualified expert on questions of armament. Regarding the merits of the two designs, as shown elsewhere in our issue, it is admitted that each has virtues which so strongly recommend it, as to prevent any offhand decision as to which is the all-round better ship. The Bradford design, with its four 12-inch, twelve 8-inch and twelve 6-inch guns, is in respect of its offensive qualities an enormously powerful vessel, and on paper it stands far ahead of any of the vessels built or building for any navy in the world. We presume that the Admiral has fully worked out the details of weights, displacement, coal endurance, etc., for this ship; but we are free to confess that even with her 17,200 tons displacement, she looks scarcely able to carry such an enormous battery with the great weight of emplacements, ammunition hoists, and ammunition, necessary to adequately mount and serve it, and at the same time find room for engines that will drive her at 19 knots, and for the large supply of coal which she must carry to bring her up to modern requirements as to sea speed and radius of action. An undue proportionment of weight to guns and armor must be accompanied by a reduction in the weights allotted to other essential elements of the ship; and the mounting of twelve 8-inch guns and the six heavy turrets in which they are installed, cannot have been accomplished, we fear, in this design without some sacrifice in other directions. We say this with due appreciation of the fact that 300 tons of extra displacement is allotted to cover these weights.

The Bowles design is marked by great simplicity and by the total elimination of one caliber of gun, reducing the number carried to three, namely, 12-inch, 7-inch, and 3-inch, as against the four sizes, 12-inch, 8-inch, 6-inch, and 3-inch, carried in the Bradford design. While it is true, as urged by Admiral Bradford in his minority report, that the Bowles design introduces yet another altogether new type of ship into the navy, we take it that it is the expectation of Admiral Bowles that the type, if adopted, will be so satisfactory that it will remain, with possible modifications, a permanent type for future ships. As regards the new 7-inch guns which it is proposed to use we consider that developments in guns and armor during the past few years point to this caliber, or perhaps, preferably, a caliber of 7½ inches, as the most desirable for what we might call the intermediate battery of battleships. The commonly accepted practice in our navy has been to install four heavy guns for penetrating the main turrets and the armor belt of an enemy; an equal or larger number of 8-inch guns for use against the lighter armor of the casemates and smaller turrets; a secondary battery of 6-inch guns, also for use against the lighter armor of the ship, and a large number of 14-pounders and 6-pounders for the purpose of attacking the unprotected portions of the ship with a storm of smaller shells. The wonderful improvement in armor, however, due to the introduction of the Krupp process, has discounted the efficiency of all guns, great and small. The 6-inch gun is no longer able to penetrate 6-inch armor at ordinary fighting ranges, nor is the 8-inch gun serviceable against the heavier belt and turret armor. At the same time the 8-inch is over-heavy for use against the more lightly armored portions of a vessel—facts which would indicate that the time has come for the introduction of a weapon of intermediate caliber, such as 7 or 7½-inch—one that would combine some of the penetrative power of the 8-inch with the rapidity of fire, light weight, and handiness of the 6-inch gun.

We have noticed in the development of foreign naval ordnance during the past year or two indications of the recognition of this necessity. The French seem disposed to throw out the 5.5 rapid-fire in favor of the 6.4 and 7.6 semi-rapid-fire gun; while England has been building a 7.5 rapid-fire gun which has already made its appearance in one of her later battleship designs. As modified by the recent extraordinary improvements in armor, we think that the desiderata in the arming of a battleship are as follows: A main battery of four heavy guns for attacking the water-line belt and main turrets; an intermediate battery of 7-inch or 7½-inch rapid-fire guns for attack on casemates and the more lightly armored turrets of the